PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF WASHINGTON

VOL. XVIII 1916 No. 3

Two Hundred and Ninety-Third Meeting,

March 2, 1916.

The 293d regular meeting of the Society was entertained by President C. R. Ely at the Saengerbund Hall, March 2, 1916. There were present Messrs. Baker, Borden, Böving, Craighead, Cushman, DeGryse, Ely, Fisher, Gahan, Greene, Heinrich, Holloway, Hopkins, Isely, Knab, Middleton, Pierce, Rohwer, Schwarz, Shannon, Snyder, Turner and Walton, members, and E. H. Gibson, H. G. Ingerson and A. T. Speare visitors.

The Corresponding-secretary announced the election of Mr. A. N. Caudell to the vacancy on the Executive Committee.

Dr. J. M. Aldrich, and Messrs. T. W. McGehee and R. W. Moreland were elected as corresponding members.

The following program was presented:

THE DETERMINATION OF THE ABDOMINAL AND THORACIC AREAS OF THE CERAMBYCID LARVAE AS BASED ON A STUDY OF THE MUSCLES.[1]

By F. C. Craighead.

INTRODUCTION.

The purpose of this paper is to establish a foundation for the subsequent description and classification of the North American cerambycid larvae (of which one part has already been published).[2]

[1] Contribution from the Branch of Forest Insects, Bureau of Entomology.

[2] Craighead, F. C., Larvae of the Prioninae, Rept. No. 107, U. S. Dept. Agr., June 25, 1915.

In the following papers on these larvae the terminology given here will be adopted. From an anatomical study of the cerambycids alone, it was found inadvisable to draw conclusions, consequently the larvae of some eight or ten other Coleopterous families have been studied more or less thoroughly. The general areas as defined here have been found to conform very well, but as to the terminology of some parts and the importance or significance given to certain areas, this paper is provisional and will be followed by another discussing a series of larval types.

Before the 274th meeting of this society Dr. Adam Böving presented a paper on the abdominal structure of certain Coleopterous larvae as based on the muscular anatomy.[1] This he stated was a continuation of Dr. Hopkins' study of the structure of the scolytid larvae.

The writer fully adopted this nomenclature in a paper on the larvae of the Prioninae[2] and found it adaptable to the abdominal structure which only was there discussed. But this paper in which a further study and correlation of both the abdominal and the thoracic structures of the cerambycid larvae is carried out, certain modifications of Dr. Böving's terminology are suggested as more generally applicable.

Dr. Böving further mentions that he believes the characters which he describes can also be used for larvae of other family or ordinal rank. I can, in this connection, state that this has been found the case in several Coleopterous families (beside those here discussed) in which the anatomy has been studied. Especially applicable is his description of the intersegmental skin, the muscles from its cunea as well as the mechanical principles involved, in the whole arrangement of folds, areas and muscles pertaining to what he calls the lateral zone.

A study of the principle of the primary segmental divisions as represented by Dr. Hopkins[3] in his study of the scolytid beetle, *Dendroctonus*, and the above discussed principle of Dr. Böving it is evident that these principles are identical, but that different terms have been used to designate the homologous areas. Thus Dr. Hopkins has shown that the pleurum is the main lateral region, divided into two pleurites, the epimeron and episternum of the adult, which he says are undoubtedly homologous to the epipleurum and hypopleurum of the larvae, and that between

---

[1] Böving, A. G., On the Abdominal Structure of Certain Beetle Larvae of the Campodeiform Type. Proc. Entom. Soc. Wash., Vol. XVI, No. 2, June, 1914, p. 55–60.

[2] Craighead, F. C., Larvae of the Prioninae, Rept. No. 107, U. S. Dept. Agr., June 25, 1915.

[3] Hopkins, A. D., Contribution Toward a Monograph of the Scolytid Beetles. Technical Series, No. 17, Part 1., U. S. Dept. Agr., 1911.

these areas lies the pleural suture. This pleurum of Hopkins is homologous to the lateral zone of Böving, but the line which corresponds to his pleural suture in the adult is in the clerid and cerambycid larvæ a somewhat oblique line, less distinct than the sutures above and below the pleurum or lateral zone. Snodgrass[1] (page 537) has shown that in the nymphs and immature stages, that line is often indistinct, which corresponds to the pleural suture of the adults. This is considered the case in the clerid and cerambycid larvæ.

Thus the principal changes in this paper will be to adopt the term pleurum for Dr. Böving's lateral zone, and for the prominent larval lines above and below pleurum (which Dr. Hopkins has not named) adopt Wallengreen[2] names of tergopleural[3] and sternopleural suture for Dr. Böving's terms antipleural and pleural suture. Dr. Böving's name for hypopleurum (which name has been used as a part of pleurum) will have to be changed and the name postcoxal (*PoCx*) is here adopted. These are the principal alterations to be made in this paper to bring about a homology of the names and to adopt terms in more general use for areas which are here considered the same.

Above the pleurum is the tergum, its divisions are called tergites; below the pleurum is the sternum, its divisions are called sternites.

The Abdominal Structure.

The following discussion and figures are based on the anatomy of the cerambycids. Not all the muscles to be found in the segments are illustrated, but the longitudinal muscles between the cunea are here omitted for the sake of clearness. One plate (Plate 9) shows these longitudinal abdominal muscles essentially like those of the clerid. These longitudinal muscles are attached to the posterior edge of one cunea extending to and attaching on the posterior edge of the cunea behind. The longitudinal muscles which extend backward determining folds within the segment, are always attached to the anterior edge of the cunea. Thus the cunea can always be defined by longitudinal muscles. Also the superior cunea can be indicated by the two fascia of the muscle *s-pn*[2] from the posterior cuneal notch. One fascia of this muscle attaches to the anterior and one to the posterior edge.

---

[1] Snodgrass, R. E., The Thorax of Insects and the Articulation of the Wings, Proc. U. S. Nat. Mus., Vol. 36, p. 511–595, 1909.

[2] Wallengreen, H., Physiologisch-Biologische Studien über Die Atmung Bei Den Arthropoden, Lunds Universitets Arsskrift, N. F., Vol. 10, 1914.

[3] Dimmock, Geo., Primer Informe Anual de la Estacion Central Agronomica de Cuba, 1906. On page 295, canal lateral, lateral furrow, is used, equivalent to tergo-pleural.

Starting with an abdominal segment of a Lepturinae larva (Plate 6) the homologies will be pointed out comparing it with a clerid, as illustrated by Böving.[1] First will be noticed a considerable reduction both in size and number of the perpendicular muscles, except those between the pleural sutures (*tp-sp*). This pleurum is strongly protuberant in this form, produced by the numerous short muscle bands from the tergopleural to the sternopleural (*tp-sp*) and postcoxal line [hypopleural line of Böving] (*tp-pcx*). These tergopleural-sternopleural muscles are absent in clerid forms as well as several fascia of the tergopleural-postcoxal muscles. The tergopleural suture is defined as in the clerid, by two sets of perpendicular muscles extending downward, one from its anterior extremity below spiracle to the posterior cuneal notch (*tp-pn*), the other from its posterior extremity to the postcoxal suture (*tp-pcx*). The sternopleural suture (*s.p.*) defined by three (in the clerid) large muscles, from its middle extending dorsad, is here represented by a single band of several fibres (*pasc-sp*). These last muscles define the ventral limit of the parascutum (*PaSc*) and the dorsal limit of the spiracular area (*SpA*) in the clerid. So do they also in the cerambycid. A longitudinal band of muscles (*e-s*) attached along a perpendicular median line [the parascutal divisor (*e*)] on the lower half of the parascutum and upper half of spiracular area extends posteriorly to the superior cunea. These muscles seem to be of little value as determining any abdominal area. In the cerambycids this parascutal area extends over the back of the larvæ around a well defined plate, the scutum (*Sc*). The parascutum and the notal subdivisions are more or less protuberant forming the ambulatory ampullæ. The writer believes the parascutum is nothing more than a portion of the notal areas as will be shown later in the thorax, but since it is of value for descriptive purposes the name should be retained. Of these notal divisions only the scutum (*Sc*) (or more correctly, the scutal plate) is well defined, first by two lateral sutures, the scutal lines (*s.c.*) defined by the large muscles (*pn-sc*), also by two transverse sutures (*a.sc* and *p.sc*) connecting the scutal lines, defined by muscles extending from the anterior line to the superior cunea behind the segment and from the posterior line to the superior cunea in front, on the same segment; also muscles from each of these lines extending in the opposite direction. These muscles defining scutum in the cerambycid and clerid cannot be absolutely homologized. In the clerid, prescutum and postscutellum are defined by muscles *s-pn* (*s-pn*[2] of Cerambycidae) and *pscl-hypl*. These muscles

[1] *l. c.*, Plates III and IV, figs. 1, 2, 3, 4.

have dropped further down in these forms and do not produce a fold defining these areas. Hence the region in front of scutum which is considered prescutum and that just behind scutum which is considered scutellum, are both indistinct. The post-scutellum is wanting.

Anteriorly beneath the sternopleural suture is a small triangle *PrSt,* which is considered the presternum. In most cerambycids it is formed more by the ampullar protuberance than by special muscles, and by this same protuberance crowded to the side, but in the thorax the ventral extremities often meet or fuse. In one subfamily, the Aseminæ, it is definied by a muscle *ps-i* [represented in the Cerambycinae figure (Plate 8)] and in the clerid and many other Coleoptera, it is well defined by two muscles *dpl-s* and *dpl-i* (of Böving) one extending to the superior and one to the inferior cunea. In the clerid the deuteropleurite and presternum are considered as fused together. Behind the presternum and below the sterno pleural suture lies the post-coxal area (*PoCx*), limited below by the postcoxal line which is defined by (Böving's hypopleurun) perpendicular muscles (*tp-pcx*) (*anti-hypl*) of Böving) from the postcoxal line (*p.cx*) to the posterior end of the tergopleural suture; and I may add this postcoxal line is (in the cerambycids) also defined by one or several muscles (*s-pcx*) to the superior cunea (probably *hypl-tepl of the clerid.*) This postcoxal area is usually more or less triangular in shape. Beneath the postcoxal area lies the coxal lobe (*CxL*). This is a conspicuous area in some cerambycid larvae, lying between the postcoxal and sternal lines. It can always be determined by two points of muscular attachments. One on the sternal line having two or three muscles (*tp-st*) to the tergopleural suture, the posterior of which represents Böving's *pscl-hypl;* the other point is on the postcoxal line defined by the muscles *tp-pcx* (clerid muscles a*nti-hypl*). From the position of these muscles in the clerid, figure 4, it will be seen that the coxal lobe is inconspicuous, the muscle almost lying on the same line, nevertheless a very small triangle can be seen on the larvæ. This is almost the case in the Cerambycinae.

In the clerid just beneath the postcoxal and coxal areas lies the parasternum. The broken line ventrally limiting it is considered the sternal line defined by muscles *s-st* and *an-st.* This area is not present in the cerambycids and only the posterior part of the line defined by muscles *pn-st* (*an-st* of the clerid) is considered as really the sternal line. The other muscles *s-st* of the clerid are only present in Leptura forms (*s-st*). Their position in these larvæ and in many other Coleoptera is so variable that for the present their significance cannot be determined. However in the clerid, elaterid and trogositid they define an

area which may well be called the parasternum for descriptive purposes. Between the sternal lines extends a transverse line, the eusterno-sternellar line (*est.stl*), separating the eusternum from the sternellum. In some larvae it is continuous with the sternal line, in others perpendicular to it, and probably more or less represents the same line, but for the sake of the discussion it is considered separately. It is defined by muscles to the posterior notch *pn-est.stl*. That part of eusternum extending dorsad to the sternopleural suture in front of the coxal lobe often becomes a separate area in the thorax.

All the ventral areas like the corresponding dorsal ones, are protuberant ventrally, forming the ampulla. Several muscles (*i-est*) extending from the eusternal region posteriorly to the inferior cunea and several (*i-stl*) from the sternellar region anteriorly to the inferior cunea are not considered as defining any definite areas or regions, but are of importance in contracting the ampullæ and producing its bilobed form in many larvæ.

A comparison of two other types of larvae, the Cerambycinae and the Prioninae, with that of the Lepturinae shows that in both these forms the pleurum is not protuberant and only one of the short tergopleural-sternopleural muscles (*tp-sp*) is present. Likewise the tergopleural suture is very indistinct, especially in Cerambycinae forms. By the stress being removed from this suture and distributed more generally over the spiracular area the region around the spiracle has assumed on ellipitical form, lying partly in the pleural zone and partly in the spiracular area. This to some extent acts as a substitute for the elastic effect of the pleural lobe which is very prominent in *Leptura* forms, indistinct on Prioninae larvae and still less evident on Cerambycinae types. Thus this tubercle or lobe becomes distinct or obsolete according to the position and strength of the sternopleural-tergopleural and other pleural muscles. In the last three abdominal segments of the Cerambycinae and Prioninae larvae the same development of pleural region and lobe is present as in all segments of the Leptura abdomen. Again in Prioninae the postcoxal line pushes downward shortening coxal lobe which is entirely lost in the Cerambycinae as the muscles indicate; those which define the postcoxal line (*tp-pcx* and *s-pcx*) having nearly the same attachment as those defining the coxal lobe. In the Cerambycinae the sternopleural suture is not defined anteriorly, thus presternum and pleurum are fused.

THE THORACIC STRUCTURE

The transition from the abdominal to the thoracic segments is a gradual one and can best be seen by comparing the integument from which all the muscles have been removed with another specimen with all the muscles in situ.

First taking a prionine larva such a comparison will show that the anterior and posterior cuneal notches gradually separate as they approach the thorax. The former pushes dorsad, the latter ventrad. This produces a lengthening of the muscles *s-pn*[2] between them, together with a gradual reduction in the number of fibers until in the metathorax but two remain. Muscle band *s-pn* becomes more horizontal and in the first abdominal segment extends entirely across the segment (*s-s-pn*), to a point on the superior cunae. This muscle is retained in the thoracic segments. The muscle defining the scutal line (*sc-pn*) loses many fibers as it approaches the thorax and suddenly disappears in these segments. It is also absent in the abdomen of some other families.

Now if the integument free of muscles is studied it will be seen that between the cuneal wedges a gradual reduction of the connecting portion of the intersegmental skin (*Is.S*) takes place towards the thorax; so that between the metathorax and the first abdominal segment the anterior and posterior notches lie nearly in the same line, and the intervening skin is very short. These wedges and notches actually come into the same plane between the first and second, and second and third thoracic segments.

This construction necessarily prohibits the telescopic movements of the abdominal segments. The longitudinal muscles between these cunea are gradually collected and narrowed into a dorsal and ventral wedge-shaped band which becomes respectively the superior (*s-rt*) and inferior retractor (*i-rt*) muscles of the head. The dorsal are attached to a point at the fusion of the posterior limit of front and the epicranial halves, the ventral at the point of fusion of the collar of prothorax, and the hypostoma. Several other lateral longitudinal muscle bands (*c-l*) are attached to the collar or skin connection between head and prothorax around the occipital foramen.

With the widening movement of the cuneal notches the parascutal line is gradually lowered but the muscle (*pasc-sp*) which defines this line gradually, approaching the thorax, moves its attachment dorsally forward until it is attached in the thorax on the anterior notch of the superior cunea (*s-sp*). In some Cerambycinæ larvæ this muscle moves posteriorly upward and becomes attached to the cunea behind [see broken muscles of Cerambycinæ figure (Plate 8).] In some Asemiinae it is attached along the scutal line and does not reach the cunea. Suddenly in the mesothorax the abdominal muscles from tergopleural suture to postcoxal area and coxal lobe or sternal line (*tp-pcx*, *tp,st*) have extended their dorsal attachment to the parascutal (now called scutal line). These muscles are collectively called

the wing leg muscles and their dorsal attachment marks the dorsal limit of alar area (*A.A.*) and the ventral limit of scutum. This alar area (so called because in abnormal larvae and also in the pupa the wing evaginates from this region) is triangular with its apex pointing downward nearly bisecting the pleurum (*P*). The sutures defining this apex are indicated by oblique muscles (*tp-pn*[1 2]) one set extending forward to the posterior notch of the inferior cunea the other backward to a corresponding point behind. The anterior band (*tp-pn*[1]) evidently is the abdominal muscles, *tp-pn*. The posterior cannot be compared with any abdominal set in the cerambycids but occur in other forms. This v-shaped suture below the alar area is considered the tergopleural (*t.p*) suture. The thoracic pleurum is usually divided into an anterior and posterior part by an oblique suture *p.s.* which is considered the pleural suture. It extends downward from the alar area and upward from the coxal lobe. It is much more prominent in some other larvae. The sternopleural suture retains its same relative position as in the abdomen. It is defined by two muscles from near its middle, one set *s-sp* already described, the other *sc-sp*, extends dorsad to the scutum representing abdominal muscle *tp-sp*. Thus the pleurum assumes a more or less crescent shape having its anterior portion truncated by the triangle bearing the spiracle while its posterior extends far dorsad. Across the alar area extends a band of muscles *a-a*, which may represent some modification of the abdominal band *d-s*.

In the Lepturinae and Priononae just in front and above the alar area is a small triangular lobe. It is formed by the wide points of attachments of the wing leg muscles and a shortening of some of the muscles *a-a* from their anterior attachment on the superior cunea. This (from its position) might belong to either alar area or scutum but is regarded as a part of the latter.

In the Cerambycinae it will be seen that the sternopleural suture is not complete anteriorly but merges with that line below it defining the posterior limit of presternum. Also the muscle *s-sp* often moves down along this line. Thus pleurum and presternum are not distinctly separated (a dotted line is indicated between them) which condition will later be remarked upon in discussing the prothorax.

It will be noticed that in the Cerambycinae and Prioninae the abdominal spiracle lies in an elliptical region the lower part of which was before mentioned as part of the pleurum. Just in front of this ellipsoid is the intersegmental skin (*Is.S.*). Also in the abdomen one muscle (*spi-pn*) is attached to the spiracle itself, and often extends to the parascutal line. Several others (*tp-pn*) define the tergopleural suture just below it. Synchro-

nomously with the pushing down of the spiracular area to form the thoracic alar area, the muscles (*tp-pn*) have become strengthened and retain their same relative position (*tp-pn*[1]) but the spiracle has moved below the tergopleural suture as the muscle (*spi-pn*) shows, which moves with it. Thus the spiracle has moved into the pleural region. This muscle is small in the metathorax with the rudimentary spiracle, but large in the mesothorax. It is of great importance in deciding the segment to which the spiracle belongs when it has apparently moved from mesothorax to the prothorax, as in some Lamiinae and other larvae.

The rudiments of the lines defining the spiracular ellipsoid can still be seen in the metathorax (especially the Cerambycinæ) but it is debatable whether to consider this region into which the spiracle has moved in the thorax as part of pleurun which it evidently was in the abdomen or to consider this spiracular triangle, as fused with the narrow piece of intersegmental skin and thus a part of it instead of the pleurum. In the mesothorax of Prioninae and Lepturinae this triangle is very sharply defined. For the sake of comparison in larvæ of other families the latter view is adopted, for the present, i.e., that the spiracle lies in the intersegmental skin of the pleurum. In another subfamily of cerambycids, Aseminae, the spiracle in the first abdominal segment has moved forward out of the ellipsoid past the line *a.s.l.* (Plate 8) into the intersegmental skin, thus giving more evidence for the latter theory.

To consider the formation of the notal subdivisions it may be well to start with the clerid in which form Dr. Böving has shown that the large muscle *s-pn* (attached very high) and the muscle *pscl-hypl* behind, cause elliptical constrictions, the prescutum and postscutellum. In the cerambycid it has been shown that the postscutellum is absent. Now from the lowered attachment of the muscle *s-pn*[2] and greater protuberance of the ampullae with its many muscles, the preponderance of stress in this region is determined by the latter, forming curved lines as the limit of the parascutum. Therefore the presternum cannot take its triangular form. But in the thoracic segments, the muscles *s-pn*[2] have pushed their upper attachment dorsad and by the loss of the large muscles *sc-pn* a poorly developed ampulla results with the consequential forming of a triangular prescutum and scutellum. Whether new sutures are formed in the thorax or the old ones modified is questionable, probably either alternative occurs in different forms of larvae. It is assumed as the muscles seem to indicate that the anterior and posterior sutures defining abdominal scutum *a.sc* and *p.sc.*, have fused medianly and diverged laterally, thus opening scutum which fuses with parascutum to form what is collectively called in the thorax, scutum (*Sc*).

From this modification and that in other larvæ evidence is suggested that the abdominal parascutum is in fact scutum crossing the dorsal part of the segment, in the median dorsal part of which a more or less rectangular plate, the scutal plate, is often defined by muscles for mechanical purposes. This of course would only be true in those forms where prescutum and scutellum are absent or do not meet medianly. For when these are developed as in the thorax of cerambycids and the abdomen of clerids it more or less dorsally restricts the scutum, but still in some forms is not entirely divided. It is believed that these notal subdivisions in various larvae cannot be definately homologized by the muscles and that the transition from the abdomen to the thorax is brought about through different alterations in different larvae.

Just in front of the mesothoracic prescutum in Prioninae and Cerambycinae is found a narrow transverse fold (*Pn.F*) extending between the dorsal attachments of muscle *s-sp*. This fold is considered intersegmental skin, and as it is of value in descriptions is named the postnotal fold.

Beneath the anterior extremity sternopleural suture will be noticed a triangle with its apex extending ventrad. This is the presternum (*PrSt*) homologous to that of the abdomen. It sometimes fuses medianly or has a median portion. The suture posteriorly limiting it is defined by three muscles (*p-cx*) to the anterior dorsal point of coxal and by several muscles (*p-i*) extending backwards to the inferior cunea. Beneath the posterior half of the sternopleural suture lies the postcoxal area, (*PoCx*) surrounding the coxa. Its posterior ventral limit is weakly defined in the Prioninae but strongly so in the Lepturinae. Just in front of the coxa and behind the presternum the lateral extremity of the eusternum is constricted off in the Priorinae and Lepturinae. This constriction is called the precoxal area (*P.Cx*). In many larvae this area becomes strongly chitinized acting as a brace in front of the coxa corresponding to the postcoxal area behind. These two areas dorsally surround the coxa and in the ceramlycids are usually fused and continuous but in many larvae are distinct and divided by a strong chitinization (often internally an appodeme). This fusion of the two areas is collectively called the epicoxal area (*PCx+PoCx*). The coxa is defined by four points, one dorsal more or less separating the precoxal and epicoxal areas, but having no muscle attachments, one posterior dorsad, one anterior ventral and one anterior dorsad. The posterior or often somewhat dorsal is defined by muscles, *sc-cx*, two diverging bands to the scutal line, and one *tp-cx* to the tergopleural sutnre. This point corresponds to that of the abdomen made by muscle *tp-pcx* on the postcoxal line. The anterior

ventral point is at the beginning of the eusterno-sternellar line and is defined by muscle *sc-cx-st*, to the scutal line, homologous to muscle *tp-st* of the abdomen. The anterior is defined by muscles *p-cx*, described before. From this lobe considered to be the coxa projects the trochanter which is moved by a muscle (*sp-t*) attached to its lower surface and to sternopleural suture. Thus that region in the abdomen called the coxal lobe can be shown to have developed the leg in the thorax. The eusterno-sternellar line extending between the coxa divides the eusternum (*ESt*) from the sternellum (*Stl*). Muscles (*e-s-i*) run anteriorly and posteriorly from it to the respective inferior cunea. The posterior of these may be considered as abdominal muscles *pn-st* and *e-s-i*. It will be seen that the abdominal muscles *i-est* and *i-stl* of the abdomen are retained in the thorax.

In the Lepturinae it was stated in discussing the abdomen that the coxal lobe was large and the postcoxal area relatively much smaller. In the thoracic segments the coxa is also correspondingly large so that in the prothorax they meet medianly. Also the postcoxal area is practically divided into an anterior and posterior half. In the Cerambycinae these coxae are still smaller, and the legs are often absent, corresponding to an indistinguishable abdominal coxal lobe. Parenthetically it might be remarked that the adults of Prioninae and Lepturinae are characterized by large conical coxae.

Again comparing the Cerambycinae it will be seen that the pleural suture of meso and metathorax does not extend forward to the inferior cunea but anteriorly the pleurum and presternum are fused. This corresponds to a similar modification in the prothorax where the pleural zone, presternum and eusternum are all fused, and the postcoxal area has been crowded back with the sternellum.

In the prothorax a lengthening of all the anterior regions has taken place to accommodate the attachments of the many muscles for moving the head. These muscles are not drawn but their prothoracic attachments are represented by dots in the figure. They occupy practically all the space not utilized by other muscles. These are all attached to the collar and none to the head proper except the inferior and superior retractor muscles. Likewise for mechanical reasons a solidification and chitinization of many of the areas has taken place. All the notal subdivisions above the alar area have been fused into the large rectangular pronotum (*PN*). In the Lepturinae this fusion often includes the alar area and is then spoken of as the protergum (*PrTg*). Beneath the pronotum, in turn, lies the alara area, the pleurum and epicoxal and precoxal areas surrounding the coxa. The muscles between these areas can readily be homolo-

gized with those of the other thoracic segments, and are lettered similarly. One muscle *sc-cx-st* from the lower limit of scutum to the ventral point of coxa has not been found in the prothorax. Anteriorly beneath the pleurum the presternum (*PrSt*) has become very large and extends entirely across the sternum. In Lepturinae it still consists of two lobes. Behind it and between the coxa lies the triangular eusternum. The anterior curved suture is defined by muscles (*e-e*) to the collar.

In the Cerambycinae some trouble may be experienced in homologizing the prothoracic areas below the alar area. As noted before the pleurum and presternum are partly fused in the meso and metathorax. This same fusion is evident anteriorly in the prothorax but posteriorly the pleural suture is usually impressed. (In some forms it is entirely absent or in others entirely present). The postcoxal area and small coxa have both been crowded back fusing with sternellum to form a narrow transverse fold. The point marked *x* on the sternopleural suture in the Prioninæ projects in an appodeme. Just above it extends two muscles to the pronotum and from it extends the muscle to the trochanter. At the inner point of the coxal lobe (*xx*) is a smaller appodeme. These two appodemes have become much extended and meet in a fine ligament inclined posteriorly over the coxa. Above this superior appodeme (*x*) extends the two muscles to protergum and from it the muscle to the leg, from the connecting ligament, extends the muscles *p-i* back to inferior cunea. In this subfamily the procusternum is rarely distinct.

The other subfamilies of the cerambycids, Aseminae, Lamiinae and Disteniinae can be easily homologized from the types which have been described.

TECHNIC

In dissecting the muscles of these larvae the most essential factor is to be certain of the attachment of each muscle in relation to the others. Ordinarily pickled larvae are so contracted that this is difficult. A number of methods of preservation were tried but by far the most satisfactory found was to inject the living larvæ with absolute alcohol. This distends the specimen, and (except in prepupal larvae) disintegrates the fat, also preserves the muscle in a tough, elastic condition. The alcohol is injected through the anus into the body cavity with a small hypodermic syringe. The pressure created inside closes the puncture when the needle is withdrawn. Specimens killed in boiling water plus a few drops of acetic acid, then injected with equal parts of 4 per cent formalin and 95 per cent alcohol, give good material from which the muscles can all be readily removed and the skin

showing the muscle attachments studied. Comparing such a skin and a specimen with the muscles intact gives a correct interpretation of their attachment and position.

EXPLANATION OF PLATES.

These plates were drawn by Miss Mary Carmody from sketches by the author. They are somewhat diagrammatic for the sake of clearness. In no segment are all the muscles drawn but are placed in two segments to avoid confusion. For the same reason several muscles are drawn with angles. The lettering is not present on every muscle on every plate but when not present it can be easily located on another plate where lettered. A few unimportant muscles are not shown in all the figures.

Capital letters represent areas; small letters separated by a dash represent muscles, by a period lines or sutures.

These figures were drawn from the internal right side of the larvae so that looking at the lines they will represent the external left side and the muscle can be imagined to be just beneath the skin on that side.

Plate VI. Lepturinae larvae (principally from *Leptura nitens*).

Plate VII. Prioninae larvae (principally from *Orthosoma*).

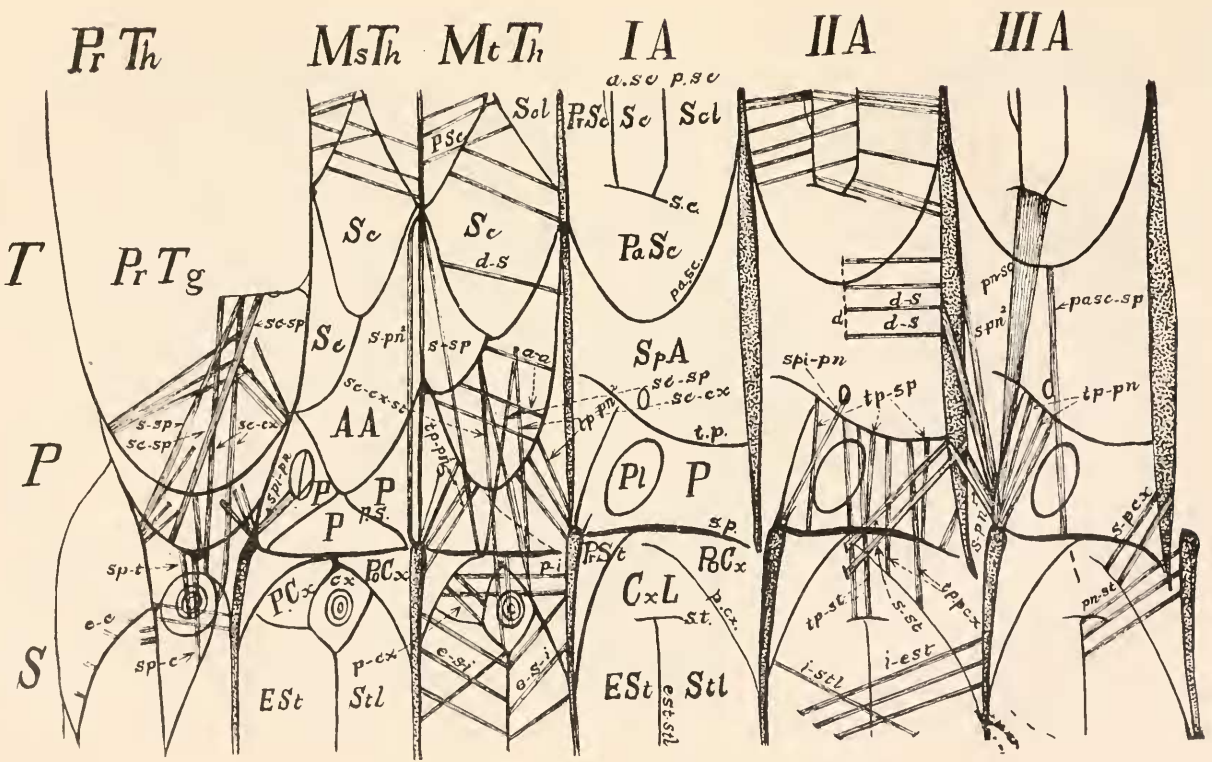
Plate VIII. Cerambycinae larvae (principally from *Chion* and *Elaphidion*).

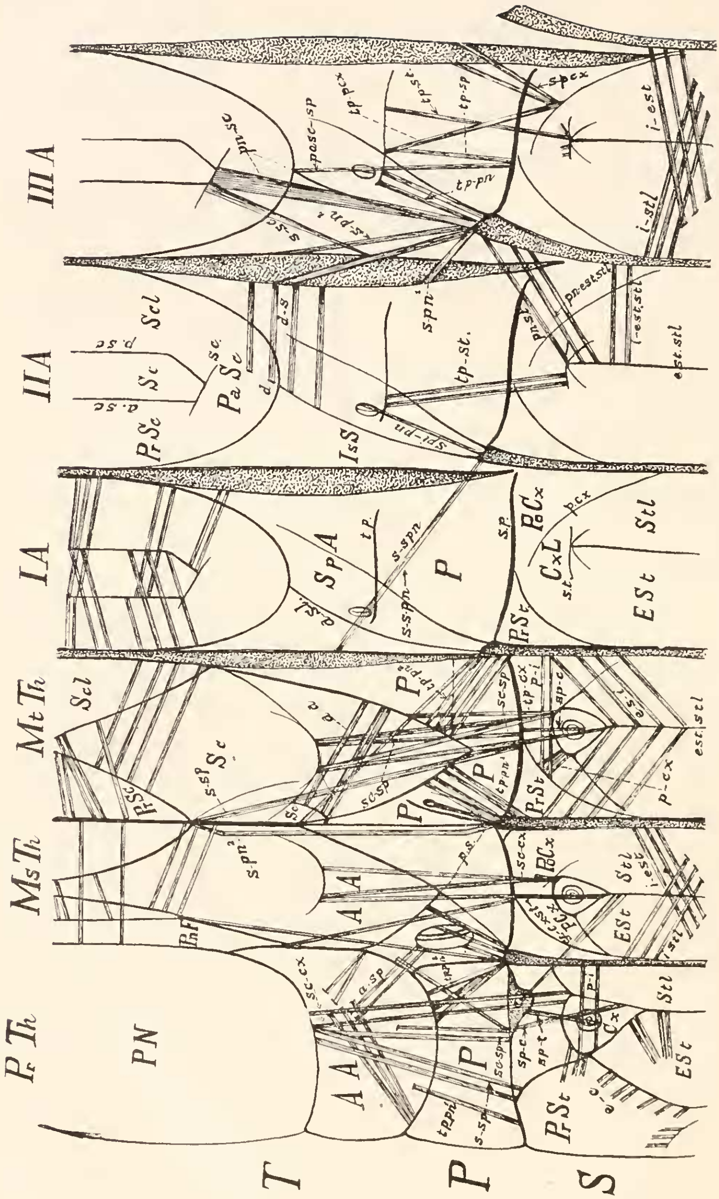
Plate IX. More important longitudinal muscles.

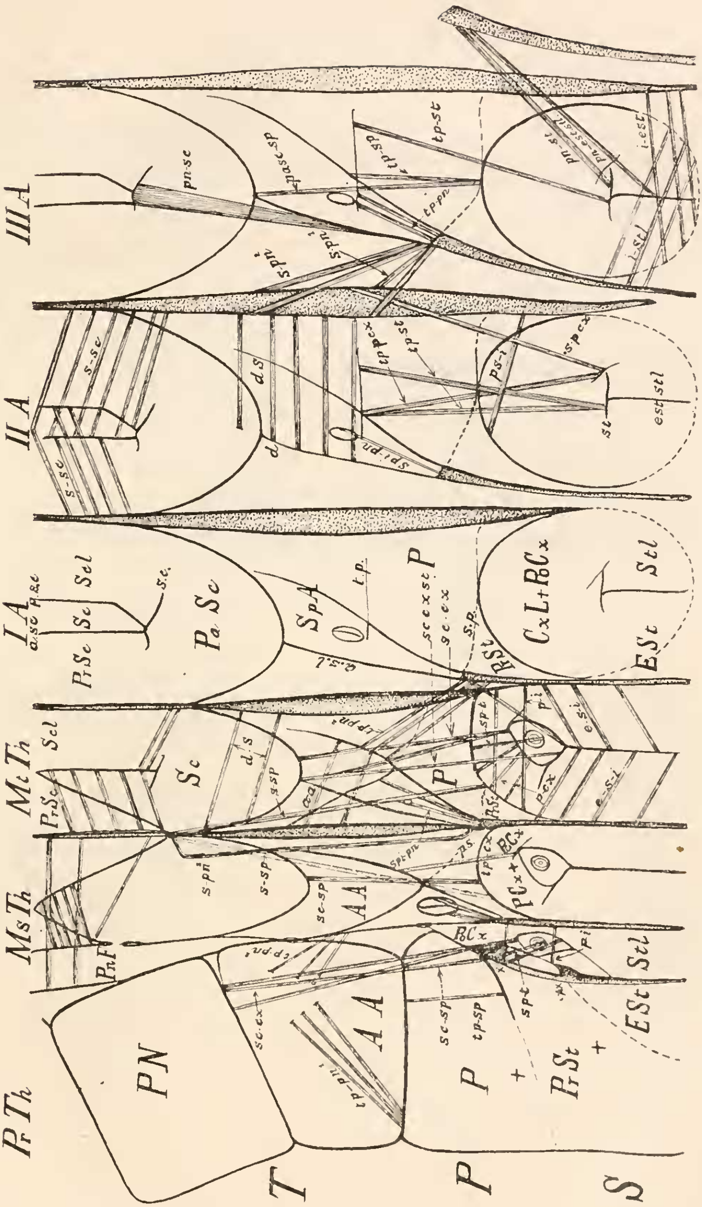
LETTERING ON PLATES.

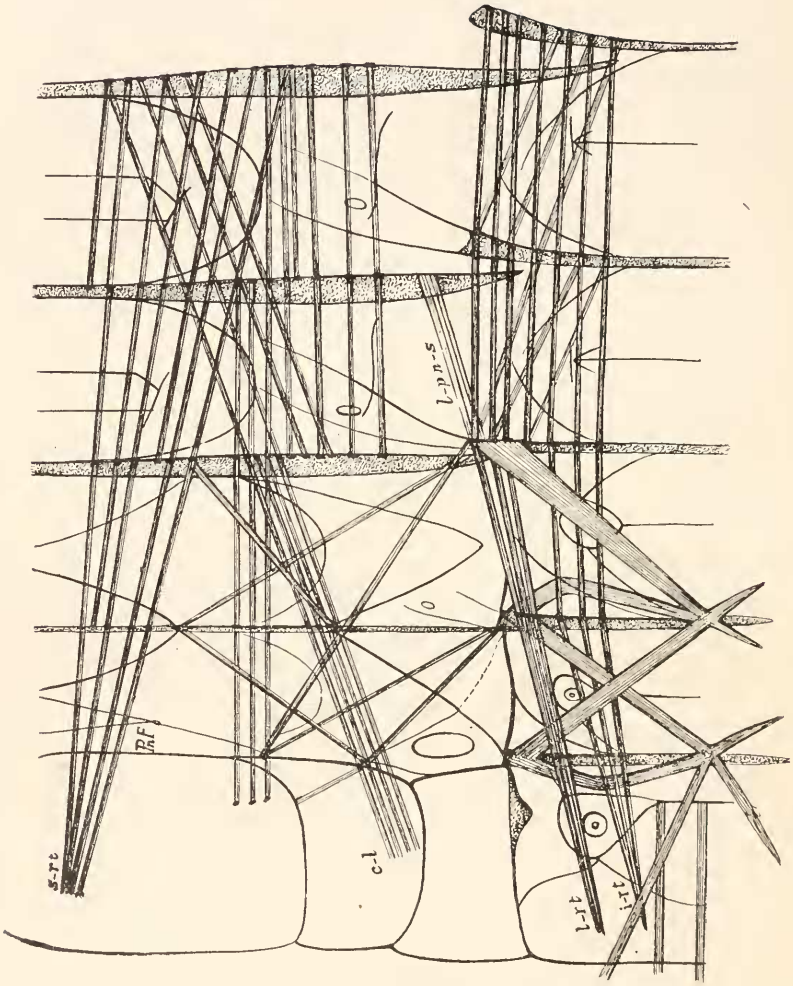
IA—first abdominal segment; *IIA*—second abdominal segment; *IIIA*—third abdominal segment; *AA*—alar area; *a-a*—muscles across alar area (thorax); *a.sc*—line forming anterior boundary of scutum or scutal plate; *a.s.l.*—line forming anterior boundary of spiracular ellipse; *a-sp*—muscle from mesothoracic spiracle to the center of the prothoracic alar area; *c-l*—longitudinal muscles from cunea to collar of head; *Cx*—coxa; *d*—parascutal divisor line; *d-s*—muscles from parascutal divisor to cunea behind; *e-c*—prothoracic muscles from eusternum to collar; *e-s-i*—sternal thoracic muscles from eusterno-sternellar line to cunea in front and behind; *ESt*—eusternum; *est.stl*—eusterno-sternellar line between eusternum and sternellum; *i-est*—muscles from central part of eusternum to cunea behind; *i-est.stl*—muscles from eusterno-sternellar line to inferior cunea behind; *i-rt*—inferior retractor muscle of the head; *IsS*—Intersegmental skin; *i-stl*—muscles from central part of sternellum to cunea in front; *l-pn-s*—longitudinal abdominal muscles from posterior notch to superior cunea behind; *MsTh*—Mesothorax; *MtTh*—Metathorax; *P*—pleurum; *PaSc*—parascutal area; *pa.sc*—parascutal line bounding this area below; *pasc-sp*—muscle from parascutal line to sternopleural suture, defining the ventral limit of parascutum and the dorsal of the spiracular area; *PCx*—precoxal area; *p.cx*—postcoxal line; *p-cx*—the muscle from posterior margin of presternum to coxa; *p-i*—muscles from posterior margin of presternum

to inferior cunea behind; *Pl*—pleural lobe; *PN*—pronotum; *pn-est.stl*—abdominal muscles from eusterno-sternellar line to posterior notch behind; *PnF*—postnotal fold behind prothorax; *pn-sc*—muscles defining scutal plate or scutum from posterior notch to scutal line; *pn-st*—muscle from sternal line to posterior notch behind; *PoCx*—postcoxal area; *PrSc*—prescutum; *PrSt*—presternum; *PrTg*—protergum; *PrTh*—Prothorax; *p.s*—pleural suture; *p.sc*—line defining posterior boundary of scutal plate; *ps-i*—abdominal muscle from posterior line of prescutum to inferior cunea behind. This muscle is only present in one subfamily of Cerambycidae; *S*—sternum; *Sc*—scutum of thorax and scutal plate of abdomen; *s.c*—scutal line, defining lateral limit of abdominal scutal plate and thoracic scutum. This line in the thorax is the same as the abdominal parascutal line; *sc-cx*—muscles from scutal line to posterior point of coxa; *sc-cx-st*—muscles from scutum to anterior ventral point of coxa near sternal line; *Scl*—scutellum; *sc-sp*—thoracic muscle from scutual line to sternopleural suture; *s.p.*—sternopleural suture; *SpA*—spiracular area; *sp-c*—prothorac muscle from sternopleural suture to ventral boundary of coxa; *s-pcx*—muscles from post coxal line to superior cunea behind; *spi-pn*—muscles from posterior notch to spiracle; *s-pn*^{1}—lower band of muscles from posterior notch to superior cunea in front; *s-pn*^{2}—upper band of muscles from posterior notch to superior cunea in front; *sp-t*—thoracic muscle from sternopleural suture to trochanter; *s-rt*—superior retractor muscles of head; *s-sc*—muscle of the Prioninae from the scutal line to superior cunea in front—also muscles from the anterior and posterior boundaries of scutal plate to superior cunea; *s-sp*—thoracic muscle from sternopleural suture or occasionally posterior boundary of presternum line to superior cunea in front or rarely behind (Plate 8 dotted muscle); *s-s-sp*—first abdominal muscle from posterior notch of second segment across first to superior cunea—a continuation of muscle *s-pn*^{1}, *s-st*—several muscles from superior cunea to a point in front of post coxal area. They may be considered as forming the anterior limit of this area or a continuation of sternal line as found in the clerids; *s.t*—sternal line perpendicular to eusternal-sternellar line; *Stl*—sternellum; *T*—tergum; *t.p*—tergopleural suture; *tp-cx*—muscle from tergopleural suture to posterior point of coxa; *tp-pcx*—muscle from tergopleural suture to postcoxal line; *tp-pn*—abdominal muscles from posterior notch to tergopleural suture; *tp-pn*^{1}—thoracic muscles homologous to *tp-pn; tp-pn*^{2}—thoracic muscles on posterior half of segment from tergopleural suture to posterior notch. These two sets pull down the alar area; *tp-sp*—muscles between tergopleural and sternopleural sutures; *tp-st*—muscles from tergopleural suture to sternal line; *x*—appodeme on sternopleural suture; *xx*—appodeme on eusterno-sternellar line.


PrTh
MsTh
MtTh
IA
IIA
IIIA
T
P
S
PrTg
Sc
AA
P
ESt
Stl
Sol
PrSc
Scl
PaSc
SpA
Pl
CxL
PCx
PoCx
sc-sp
s-pn
s-sp
sc-cx
sc-cx-st
spi-pn
tp-sp
tp-pn
t.p.
sp.
sp-t
e-e
sp-c
p-cx
e-si
o-s-i
pasc-sp
pn-st
i-est
i-stl


PrTh
MsTh
MtTh
IA
IIA
IIIA
PN
T
P
S


IIIA
IIA
IA
PN
AA
T
P
S


l-an-s
RF
s-tr
c-l
l-tr
i-tr